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Short Communication

SHORT COMMUNICATION

Human and animal health on three continents—a biography of the early life of Karl Friedrich Meyer (1884–1974)

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One sentence summary: Karl Friedrich Meyer (KF) is one of the true forefathers of the 'one health—one medicine' concept; he researched botulism, listeriosis, brucellosis, plague, ornithosis, Western equine encephalitis, mussel poisoning and clostridia.
Editor: Patrik Bavoil

ABSTRACT

Karl Friedrich Meyer (KF) was born and educated as a veterinarian in Europe; he researched infectious diseases in Europe, South Africa and the United States. He is one of the true forefathers of the 'one health—one medicine' concept. The broad scope of his research covered botulism, leptospirosis, brucellosis, plague, ornithosis, Western equine encephalitis, mussel poisoning and clostridia. This manuscript adds some more details of his early biography.

Keywords: Karl Friedrich Meyer (KF); biography; veterinarian; microbiologist; one health–one medicine; zoonosis

INTRODUCTION

In 2014, we could celebrate Karl Friedrich Meyer's (KF) 130th birthday and commemorate his death 40 years ago. There are a number of biographies or biographic memoirs on KF Meyer (Cavanaugh 1974; Steele 1974; Schachter 1977; Sabin 1980) and the transcription of an interview conducted in 1961–62 (Tartaul-Daniel 1976). In addition, Meyer can be seen and heard in an interview recorded in 1970 telling a story about the first isolation and diagnosis of a case of Western equine encephalitis in California in 1930 and put on YouTube in 2011 by the American Society of Tropical Medicine and Hygiene. (http://www.youtube.com/watch?v=WvgGZB6RFIc#t=47). This manuscript is not meant to repeat these biographies, which list and comment on KF Meyer's scientific accomplishments in detail; however, it will add some new information from documents found in several Swiss archives.

As a veterinarian living and working on three continents (Europe, Africa and the USA), studying infectious diseases of animals and humans as well as zoonoses, KF Meyer has to be considered together with Rudolf Virchow, Theobald Smith and others as one of the true forefathers of what today is described by Calvin Schwabe's concept 'One Health—One Medicine' (Dolman and Wolfe 2003; Kaplan and Echols 2009). Recognizing that human health, animal health and ecosystem health are inextricably linked, One Health seeks to promote, improve and defend the health and well-being of all species by enhancing cooperation and collaboration between physicians, veterinarians other scientific health and environmental professionals and by promoting strengths in leadership and management to achieve these goals (www.onehealthinitiative.com).

In 1954, KF Meyer reviewed the state of the animal reservoir of diseases, by then referred to as zoonotic diseases,

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before the World Health Organization (WHO) General Assembly. He repeated the same theme before the WHO Expert Committees for zoonoses, plague and food hygiene and for the Pan American Health Organization until his 90th year of life (Steele 2008).

The anniversaries of his birth and death warrant another look into the life of this famous researcher in public health.

He was born in 1884, the very year when at the Congo Conference in Berlin the division of Africa into colonies was concluded. In his later life, he experienced this political situation while working in South Africa.

In a biographical memoir, Albert D. Sabin (1980) characterized KF, as he was called by his friends and colleagues, as follows: 'Karl Friedrich Meyer an outstanding bacteriologist, experimental pathologist, virologist, epidemiologist, ecologist and a brilliant and inspiring academic teacher and a prototype of the scientist in the service of society'.

Some of his major achievements were:

Control of botulismus (Wagner, Meyer and Dozier 1925; Meyer 1956, 1973; Gangarosa *et al.* 1971);

Establishment of an international center for the classification and identification of Clostridia (Elberg and Meyer 1939);

The sylvatic cycle of plague (Meyer 1957);

Deeper insight into the epidemiology of brucellosis (Meyer and Eddie 1949; Elberg and Meyer 1958; Meyer 1956);

Understanding ornithosis vs. psittacosis (Meyer 1957);

First isolation of the Western Equine Encephalitis virus (Meyer, Haring and Howitt 1931) and description of the pathogenesis (Larsell, Haring and Meyer 1934);

The role of dinoflagellates in transmitting mussel poisoning;

Deeper insight into leptospirosis (Meyer and Stewart-Anderson 1939).

Productive enthusiasm also illuminated his hobbies (Dolman and Wolfe 2003):

Color photography

Philately

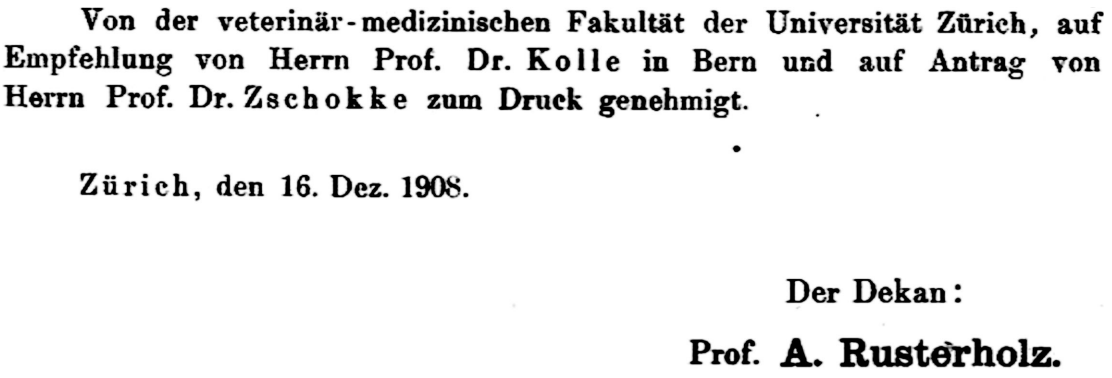
Disinfection of mail

FAMILY BACKGROUND, CHILDHOOD AND SCHOOL EDUCATION IN SWITZERLAND (1884–1902)

KF was born in Basel, Switzerland on 19 May 1884, as the oldest child and only son of Sophie Meyer (Lichtenhahn, 1857–1936) and Theodor Meyer-zum Pfeil van Büren (1852–1934), in an upper middle-class family with its roots traceable back to the 14th century (Bernhard Meyer zum Pfeil 1488–1558). KF's paternal grandfather, Friedrich Meyer (1816–95), served as state veterinarian for the Canton Basel-Stadt; his maternal grandfather, Carl Johann Lichtenhahn (1805–60), a notary, was appointed highest cantonal parliamentary clerk (Ratsschreiber) for the Canton Basel-Land. At the time of KF's birth, the family lived in Basel's old center in a historic house at Rheinsprung 21, in the neighborhood of the old university (founded 1460) and overlooking the river Rhein. His father was a wealthy merchant, importing cigars from Cuba and Indonesia to Switzerland and the rest of Europe. Later the family grew with two daughters, one of whom died in her early thirties due to a Staphylococci sepsis (Tartaul-Daniel 1976). KF attended a private elementary school (Evangelische Volkschule, Schweizer Reformierte Kirche). After four years at this school, he continued his education first at the 'Humanistisches Gymnasium', studying German, English, French, Latin and Greek and later continued for the last two school years at 'Obere Realschule', a school more oriented toward natural science. At that time the school was rather unique in running a teaching laboratory for chemistry, physics and natural history (http://query.staatsarchiv.bs.ch/query/detail.aspx?ID=79881). KF's lifelong impatience with what he regarded as 'non-sense', illogical or factually unproven developed fully during his later gymnasium years (Sabin 1980). In 1902, at the age of 18, he graduated second in his class from the 'Obere Realschule', Basel. Neither KF himself nor any of his biographies mention his having done his obligatory military service in the Swiss army. A male of his social status and education would at that time have been an officer-in-training; however, KF is not listed as an officer in the officers' register available at the Swiss Federal Military Library (S. Häsler 2014; personal communication).

ACADEMIC EDUCATION (1902–08)

According to the curriculum vitae in his second dissertation (1924), he devoted the winter of 1902/1903 to private studies in the natural sciences, then started his academic education at the University of Basel (Philosophische Fakultät), specializing in zoology under Professor Friedrich Zschokke (1860–1936), whom he praised as an excellent teacher and role model. During the summer term 1903, he joined the liberal-democratic student fraternity Helvetia in Basel and remained a member until summer term 1904. The fraternity turned out to be too small for the two alpha personalities E B (1882–1956), a medical student later to become a famous orthopedic surgeon, politician and Swiss major general and KF. The annual fraternity report for 1903/1904 records what were obviously embarrassing controversies between students leading to numerous fencing bouts. KF left the fraternity Helvetia and joined the more conservative non-fencing fraternity Zofingia (S. Häsler 2014; personal communication). In 1904, he moved to the University of Zurich to study veterinary medicine at the Veterinär-Medizinische Fakultät Zurich (State Archive Kanton Zurich, signatures: UU 25.41, UU 25.42, UU 25.43.), which had only been part of the University of Zurich since 1901. Besides studying, he spent a great deal of time in the laboratory of Professor Heinrich Zangger (1874–1957, Head of Physiology and Pathology at the Veterinär-Medizinische Fakultät from 1906. Professor for Forensic Medicine at the University of Zurich Medical School.). Zangger became an academic advisor to KF, who acknowledged the importance of his mentor's advice in the development of his career (Anonymous 1967). There also he met Walter Frei, with whom he would later work in South Africa. In 1905, he moved to the Ludwig-Maximilians Universität in Munich, Germany to continue his studies at the Medizinische Fakultät and the 'Tierärztliche Hochschule' (not part of the Ludwig-Maximilians Universität in Munich as a faculty until 1914). Returning to Switzerland in 1906, he finished his veterinary education at the Veterinär-Medizinische Fakultät of the University of Berne in 1908 and received his diploma on 24 March 1908. In parallel, he worked and prepared his doctoral thesis at the Bernese 'Institut zur Erforschung der Infektions-Krankheiten' under Professor Wilhelm Kolle (1868–1935) who had graduated under Robert Koch. In 1908, KF received the degree of 'Doctor medicinae veterinariae' from the University of


Von der veterinär-medizinischen Fakultät der Universität Zürich, auf Empfehlung von Herrn Prof. Dr. Kolle in Bern und auf Antrag von Herrn Prof. Dr. Zschokke zum Druck genehmigt.

Zürich, den 16. Dez. 1908.

Der Dekan:

Prof. A. Rusterholz.

Figure 1. Reviewers of KF Meyer's doctoral thesis in veterinary medicine 1908.

Zurich with a thesis entitled 'Über die durch säurefeste Bakterien hervorgerufene diffuse Hypertrophie der Darmschleimhaut des Rindes. (Enteritis hypertrophica bovis specifica)' (Diffuse hypertrophy of the intestinal mucosa in cattle caused by acid fast bacteria (Enteritis hypertrophica bovis specifica; Meyer 1908). Under the deanship of Professor Arnold Rusterholz, his thesis was reviewed by Professor Wilhelm Kolle and Professor Heinrich Zangger (Fig. 1). The corresponding address on the printed thesis was: 'Pathologist in the Veterinary Bacteriological Division of the Department of Agriculture of Transvaal in Pretoria'.

ONDERSTEPOORT (SOUTH AFRICA 1908–10)

Since, KF's father was reluctant to further finance an unpaid academic career (From the study records of KF's fellow student Hans Heusser, one can see that the tuition fee for a five year education in veterinary medicine from 1903 to 1908 was at that time CHF 1509, which equals CHF 15 090 today.). Professor W. Kolle found him a job at the recently established (8 October 1908) Transvaal Department of Agriculture's Veterinary Bacteriological Laboratories at Onderstepoort, South Africa. Kolle knew South Africa from the time he spent there as an assistant to Robert Koch on a campaign against Rinderpest in 1886 (Koch 1897a,b; Blumberg 1989). This institution was headed by the later Sir Arnold Theiler (1867–1936, knighted in 1914), a Swiss veterinarian who emigrated to South Africa in 1891. Theiler was looking for Swiss-trained veterinarians for the newly established laboratory and hired KF as a pathologist and Walter Frei (Later to become the head of the Institut für Veterinärpathologie at the Veterinärmedizinische Fakultät in Zurich from 1911 to 1953; KF knew Walter Frei as a fellow student from Zurich.) as a bacteriologist (Bigalke and Verwoerd 2008; Figs 2 and 3). The main tasks for the new laboratory were research into the nature, transmission and prevention of diseases of cattle and horses that were of great economic importance to South Africa, such as Rinderpest, African horse sickness, East Coast fever, red-water (Texas) fever, bovine pleuropneumonia, anthrax, glanders and other obscure parasitic and bacterial infections (Sabin 1980). KF worked long hours preparing rabies vaccine and performing hundreds of routine diagnostic post-mortems on farm animals (Fig. 4). For recreational breaks in his laboratory work, he went horseback riding in the vicinity of the institute (Sabin 1980).

KF's relation with Arnold Theiler was not easy. Many of his colleagues had serious problems with Theiler's personality. KF described this cooperation as follows: Theiler 'was a typical Lucerne square-head (although he was actually not from Lucerne but born in Frick, Canton Aargau, Switzerland), and a Lucerne square-head cannot get along very well with a Basel square-head'. (Tartaul-Danile 1976) as he called himself self-critically. The final clash occurred in 1909, when KF published results from his research against Theiler's wishes (Meyer 1909b,a, 1910); Theiler wanted results from research done in his institute to be published under his name alone. KF worked at the institute until 1910, but Theiler and he did not speak to each other anymore (Gutsche 1979).

UNIVERSITY OF PENNSYLVANIA (1910–13)

In 1910, KF decided to leave Onderstepoort and return to Switzerland, planning to work at Kolle's laboratory in Berne. On his cruise back to Europe, he met and entertained the wife and daughter of a former British ambassador to the United States. Back in Switzerland he felt depressed and happily accepted an invitation from the ambassador to his castle in Bled (Slovenia). There the ambassador convinced him that the USA should be the country of his future. It happened that the ambassador held an honorary degree in law from the University of Pennsylvania. Through his contacts with this university the ambassador was able to inform KF of an open position as assistant professor in pathology and bacteriology. KF interviewed there and took the job. His mentor in Philadelphia was Dr Richard M. Pearce (1874–1930), professor of pathology at the University of Pennsylvania School of Medicine (Sabin 1980). At first, the faculty made him feel welcome, and he soon became a member of the Philadelphia Pathological Society and other research societies. However, he also soon started criticizing the students for their poor learning attitudes. Since the faculty and university relied on student tuition fees, they told him to refrain from this criticism. At research meetings, KF was not shy in criticizing his fellow researchers either, so much so that Theobald Smith and his colleagues called him 'an aggressive Swiss veterinarian' (Dolman and Wolfe 2003). Although KF met and discussed his successful research with established and well-known older colleagues like Theobald Smith (1859–1934; Dolman and Wolfe 2003) Frederick Novy (1864–1957), Alfred S. Warthin (1866–1931), Victor Vaughan (1851–1929) and Paul de Kruif [1890–1971, in later years, Paul de Kruif described KF as 'the most versatile microbe hunter since Pasteur' (De Kruif 1926; Pickerell and Dornin 1968; Altman 1974).], a scientist of his generation. KF was to some extent appreciated by these leading colleagues; however, he felt disappointed and early in 1913 was told that he did not fit into the Pennsylvania environment (Tartaul-Danile 1976).

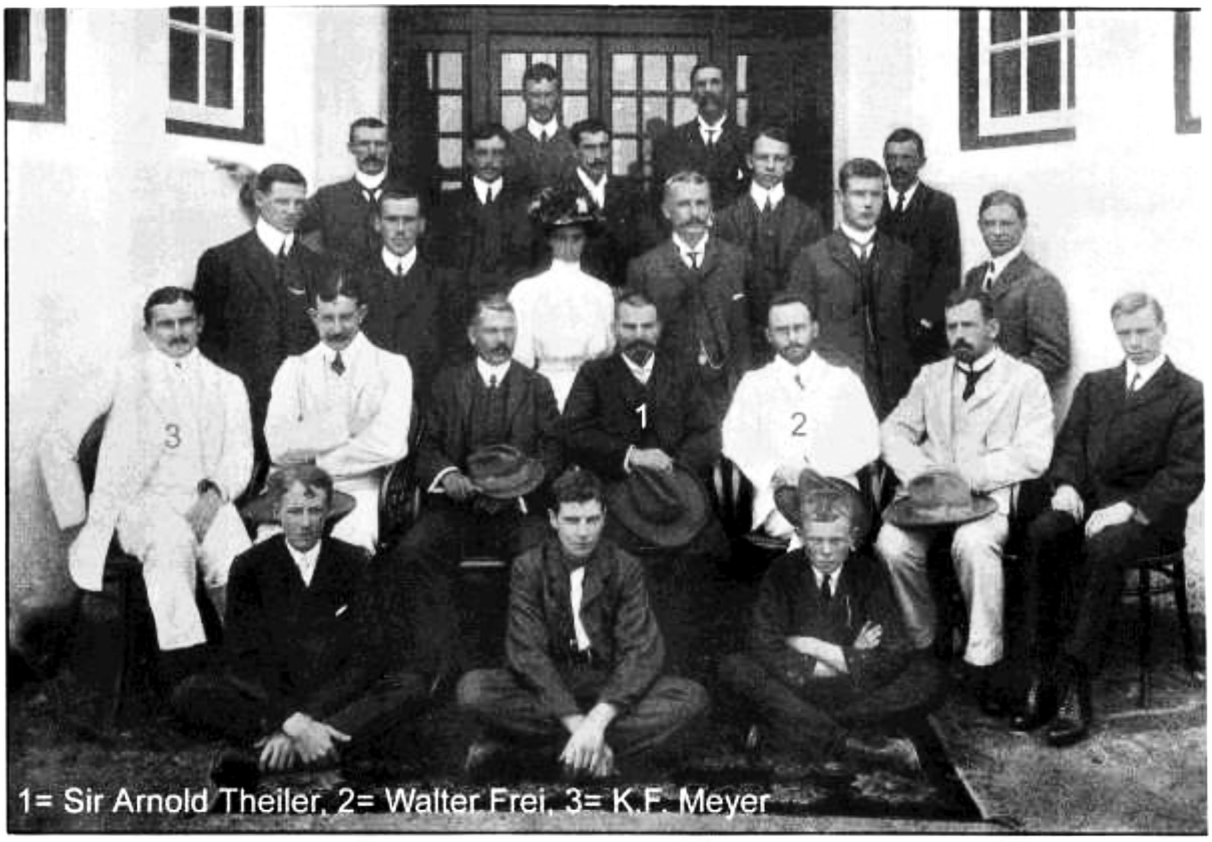


Figure 2. Staff of the Veterinary Bacteriological Laboratories at Onderstepoort, Pretoria of the Transvaal Department of Agriculture.

CALIFORNIA (1913–74)

KF was seeking better opportunities for his further career in science and applied to Simon Flexner (1863–1946) for a sabbatical year in the Department of Animal Pathology at the Rockefeller Institute (Dolman and Wolfe 2003). However, his mentor Pearce had just come back from Berkeley, where he learned that there would soon be an opening in the Department of Pathology at the Medical School and that the University of California had just received a large gift from a Mrs Hooper to establish an Institute for Medical Research that could become the Rockefeller Institute of the West (Sabin 1980). Flexner wanted to convince KF to join him in New York and told him that most of the intellectual wealth and resources of the United States lay within 500 miles of New York. In California, he said, an able scientist might get lost in the desert or drowned in the Pacific (Dolman and Wolfe 2003). Nevertheless, KF accepted the appointment as associate professor of bacteriology and protozoology at Berkeley on the understanding that he would be promoted to full professor the following year. After acceptance of this appointment, KF married Mary Elizabeth Lindsay, whom he had met earlier in Philadelphia and left for Europe for several months before moving to California in October.

During his first years in California, KF largely developed his own teaching program devoted to excellence. Being demanding on students, insisting that things be done right or not at all, he gained a reputation as a unique, but brilliant and enchanting teacher. The number of students in microbiology soon grew to almost 300 per year. In 1914, George F. Whipple (1878–1976) from Johns Hopkins joined the George Williams Hooper Foundation for Medical Research with laboratories in San Francisco to become its first director and established the foundation as the research center of the medical school. On a recommendation from Dr Richard Pearce, Whipple offered KF a position as associate professor of tropical medicine, specializing in infectious diseases and immunology at the Hooper Foundation. KF accepted the position in 1915 and moved from Berkeley to San Francisco where he had more time and better laboratories for his research (Figs 5 and 6), but still continued to teach his students by regularly commuting to Berkeley several times a week.

He was interested in public health issues from the beginning and became actively involved in the San Francisco and California State Health Departments. All his future research on typhoid, brucellosis, botulism, plague, ornithosis, plague and equine and human encephalomyelitis were initiated through his involvement with the public health activities in California.

He returned to Switzerland in 1922 and registered as a doctoral student at the Philosophische Fakultät II of the University of Zurich to complete a second thesis entitled 'The "Bacterial Symbiosis" in the Concretion Deposits of Operculate Land Mollusks of the Families Cyclostomatidae and Annulariidae' under the supervision of Professor Jean Strohl [1886–1942, born in Bischwiler, Alsace, a boyhood friend of Albert Schweizer studied zoology at the university of Freiburg, Germany, specializing in physiology, later became professor of physiological zoology at the University of Zurich. In 1921, together with Henry E. Siegerist (1891–1957) and others he became a founding member of the Swiss Society for the History of Medicine and Sciences (http://www.sggmn.ch; Anonymous 1971).] at the

TRANSVAAL DEPARTMENT OF AGRICULTURE.

Minister for Agriculture :—The Right Hon. General Louis Botha, P.C.
Director of Agriculture :—F. B. Smith, Esq.

The Veterinary Bacteriological Division.

Government Veterinary Bacteriologist :—

Arnold Theiler, C.M.G., Schweiz. Tierarz. Staats-diploma ; Dr. Med. Vet. University, Berne ; Hon. Associate R.C.V.S., London ; Associé étranger de la Société de Pathologie Exotique, Paris ; Membre Corresp. de la Société Centrale de Med. Vet., Paris ; F.R.S., South Africa.

Assistant Government Veterinary Bacteriologists :—

James Walker, M.R.C.V.S.

Walter Frei, Schweiz. Tierarz. Staats-diploma ; Dr. Med. Vet. University, Zurich.

Zoologist :—

Lewis Henry Gough, Phil. Dr., Basle.

Pathologist :—

Karl Friedrich Meyer, Schweiz. Tierarz. Staats-diploma ; Dr. Med. Vet. University, Zurich.

Superintendent :—

E. B. H. Parkes, B.A., Cantab.

Clerical Staff :—

H. W. R. King.
C. F. Hinds.
F. T. Mauchle.
J. C. H. v. d. Heever.
C. Antill (Messenger).

Lay Assistants :—

Theo. Meyer.
R. J. White.
W. F. Averre.
J. F. Schultz.
T. J. M. Devers.
F. Cochius
Miss L. Basson.

Farm Foreman : W. B. Beeton.
Farrier : S. B. Tees.
Storekeeper : J. B. Gildea.
Caretaker : F. W. Pfister.
Yard Foreman : R. J. Varley.
Engineer : S. Solomon.
Assistant Engineer : W. R. Palmer.

Figure 3. List of staff of the Veterinary Bacteriological Laboratories at Onderstepoort, Pretoria of the Transvaal Department of Agriculture.

Figure 4. KF Meyer at work in the pathology laboratory at Onderstepoort, Pretoria.

Figure 5. KF Meyer at work in the pathology laboratory at the Hooper Foundation in 1918.

Vergleichend-Anatomisches Institut of the University of Zurich. The thesis describes several complex experiments trying to clarify the role of intracellular concretion deposits interpreted as symbiontic bacterial agents in jawless fish and operculate land snails. KF could find out that the intracellular concretion deposits were not symbiontic bacterial agents but temporary storage reservoirs of metabolic origin. It is obvious that KF finished a thesis at a philosophical faculty, so that it would be accepted as a PhD equivalent in the United States and thus further his academic career.

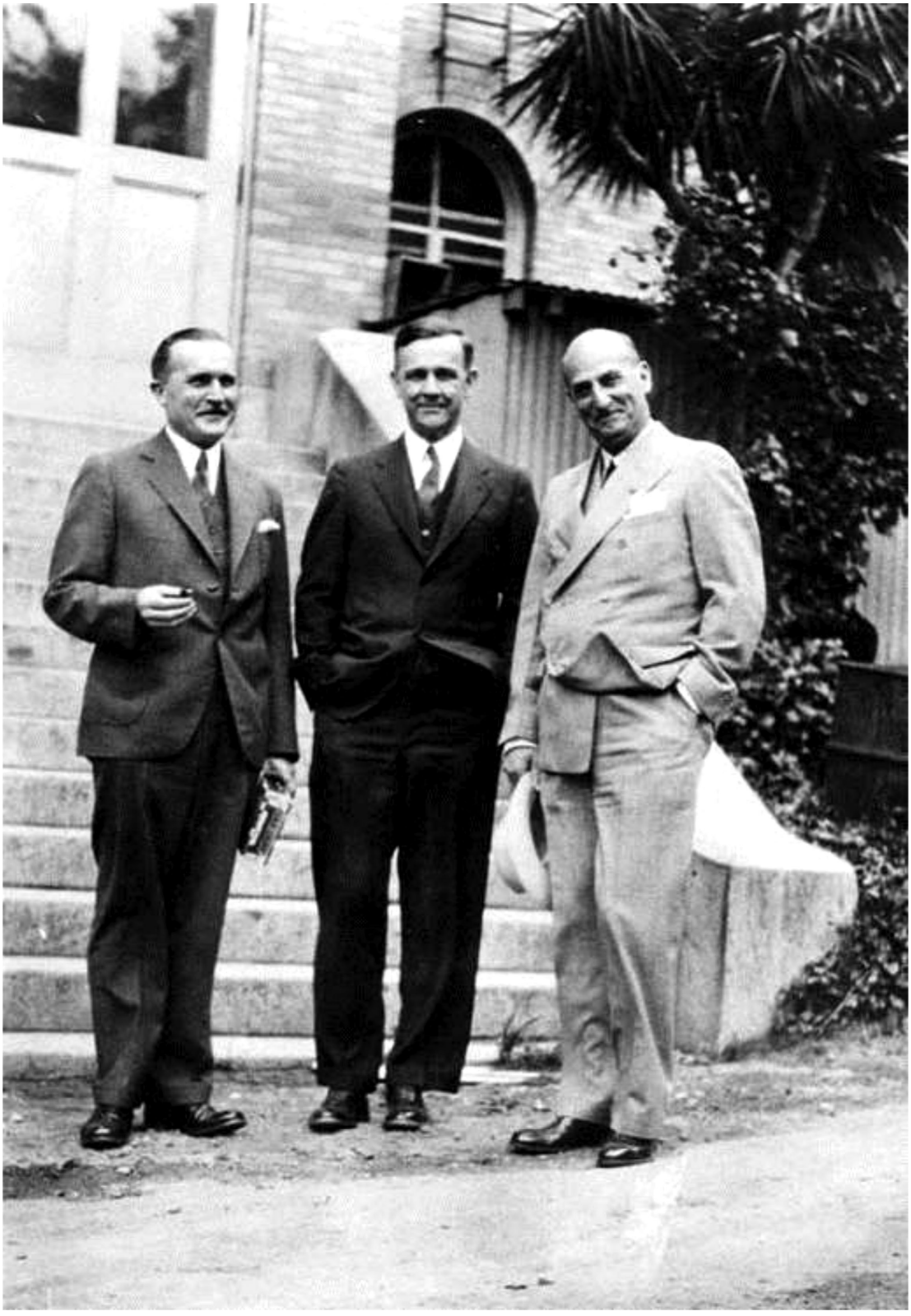


Figure 6. KF Meyer (left) and George Whipple (center) at the Hooper Foundation approximately 1920.

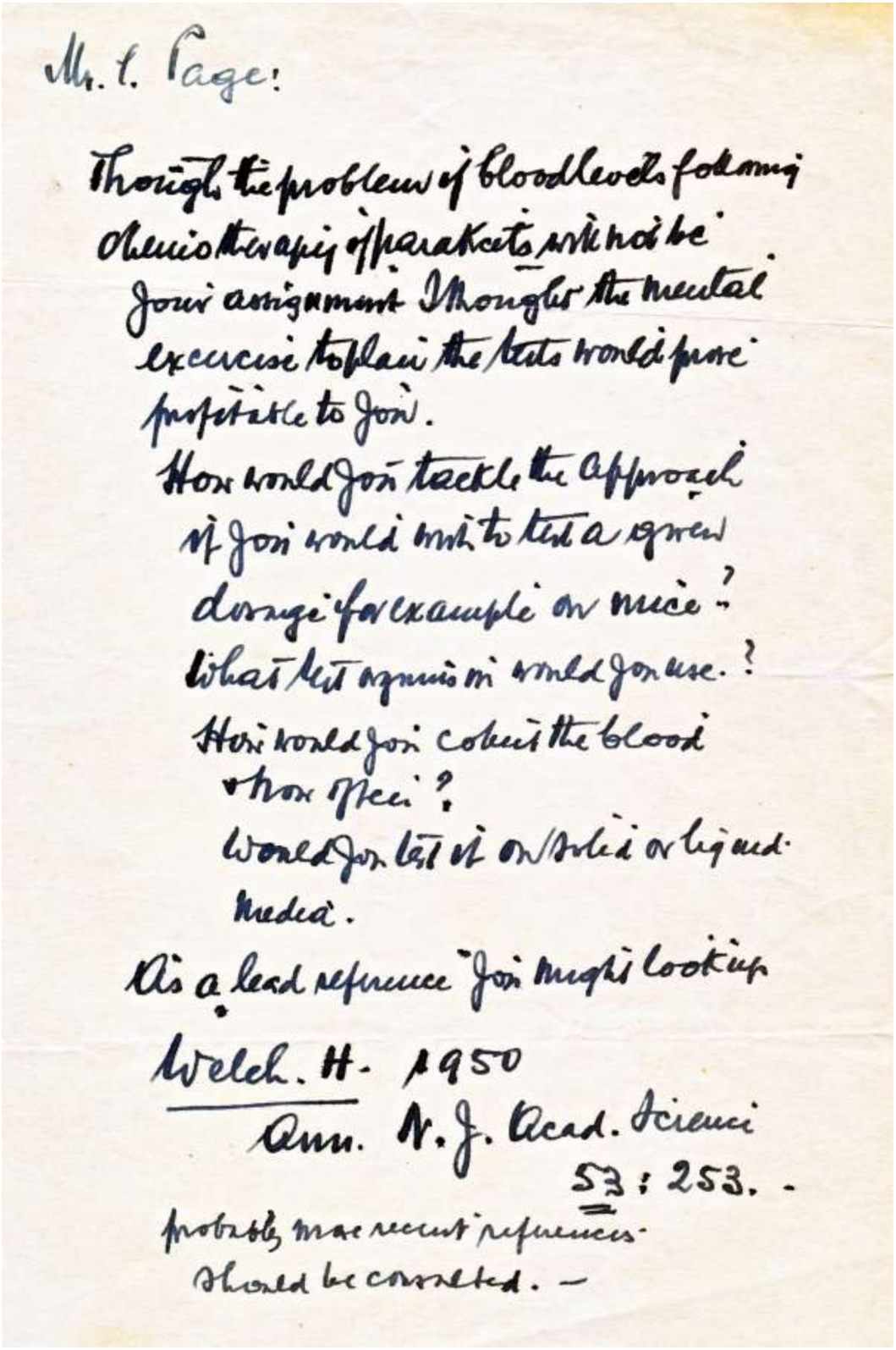
Figure 7. KF Meyer (1964) holding the 'Karl F. Meyer Gold Headed Cane Award' established by the 'Conference on Public Health Veterinarians' as first awardee in recognition of his many outstanding contributions to the advancement of public health in the United States and throughout the world.

In 1924, KF was promoted to director for medical research at the Hooper Foundation continued and served in this post until his retirement in 1954, continuing to work at the laboratories at Hooper for another 20 years until 1974 (Fig. 7). He was actively involved into several projects like the establishment of a new taxonomy for Chlamydiaceae (Storz and Page 1971) and gave his advice to others freely, e.g. in meticulously handwritten letters (Fig. 8).

DISCUSSION

The summary of the career and accomplishments of an outstanding researcher in the field of 'one health—one medicine' is perfectly summarized in the laudation for KF on the presentation of his Lasker award as follows:

> Among his accomplishments is a major share of responsibility for the control of botulism, and for a classification and international identification center for the clostridia; for our recognition



Mr. L. Page:

Through the problems of bloodleads following chemotherapy of parakeets will not be your assignment I thought the mental exercise to plan the tests would prove profitable to you.

How would you tackle the approach if you would wish to test a agent dosage for example on mice?

What test organisms would you use.?

How would you collect the blood & how often?

Would you test it on boiled or liquid media.

As a lead reference you might look up

Welch. H. 1950

Ann. N. J. Acad. Science

53 : 253. -

probably more recent references should be consulted. -

Figure 8. Undated (probably 1950s) handwritten letter of KF Meyer to Les Page with comments on birdseed impregnated with tetracycline was being developed to treat ornithosis in parakeets.

that plague is sylvatic, not merely rat-borne; for understanding of the broad spectrum of brucellosis rather than restricted goat-borne Malta-fever; for the concept of ornithosis rather than psittacosis; for the first isolation of the western equine encephalomyelitis virus and elucidating the role of the arthropod vector involved; for showing that western ticks are also responsible for relapsing fever; for studying the dinoflagellate causing mussel poisoning; for increasing our knowledge of leptospirosis; for valuable assistance with investigations of Q fever.

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Conflict of interest. None declared.

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